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Enzymatic activities of naturally occuring mycorrhizae of spruce seedlings : acid p-NPP-phosphatase

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INTRODUCTION

The poor availibility of phosphorus is a limiting factor for plant growth, especially in acid, humic forest soils. Mycorrhizal fungi stimulate uptake of phosphorus to different extents depending upon mycorrhizal type (BOWEN and THEODOROU, 1967). P-uptake seems to be a metabolic process and phosphatase activity an important parameter of its efficiency. In pure culture different mycorrhizal fungi vary in their phosphatase activity (HO and ZAK, 1978). In this study we investigate whether mycorrhizal fine roots also exhibit different acid phosphatase activities.

MATERIALS AND METHODS

Spruce seedlings were collected from different stands and mycorrhizal fine roots analysed for acid phosphatase activities. From each seedling, a mycorrhizal pair comprising *Cenococcum* and one other type was assayed. From a single stand several types were studied. The mycorrhizal roots were homogenized and the acid phosphatase activities determined according to the method of TABATABEI and BREMNER (1971) with p-NPP as substrate. Kinetic constants (K_m and V_{max}) were measured for mycorrhizae of high and low phosphatase activities using Lineweaver- Burk transformation of the Michaelis-Menten equation. Phosphatase activities of the soils were determined by the same method.

RESULTS AND DISCUSSION

Table 1 shows that acid phosphatase activities measured in various soils are very small compared to that found in mycorrhizal fungi in liquid culture or in mycorrhizal roots.

Acid phosphatase activities of different mycorrhizae range from 0.67 to 16.9 µmols Nitrophenol.g^{-1} dry wt. .min^{-1}. We have found that *Cenococcum geophilum* shows relative low activities (0.24 to 5.1) compared to other mycorrhizal types on all the stands assayed, whereas the most efficient mycorrhizal type shows activities in the range of 6.8 to 16.9 µmols Nitrophenol. g^{-1} dry wt. .min^{-1}. The fact that different mycorrhizal types from one seedling vary in their phosphatase activities suggests that the soil conditions could only influence but not cause this variation.

Kinetic constants measured for mycorrhizae of high and low phosphatase activities were different. V_{max} and affinity of enzyme to substrate ($=1/K_m$) for *Cenococcum* was lower than that of the very efficient mycorrhizae.

Table 1. Levels of acid phosphatase activities in soils, mycorrhizal fungi and mycorrhizal fine roots

	Phosphatase activity µmols Nitrophenol .g^{-1} dry wt. .min^{-1}	
Location	Activity	References
Soils	0.01	Tabatabei, 1971
	0.03	Tabatabei, 1971
	0.06	Tabatabei, 1971
	0.08	Tabatabei, 1971
	0.09	Polomski *et al.*, 1984*
	0.15	Polomski *et al.*, 1984*
Mycorrhizal fungi in liquid culture	0.27	Ho and Zak, 1979
	4.47	Ho and Zak, 1979
	5.58	Ho and Zak, 1979
	9.64	Ho and Zak, 1979
Mycorrhizae in soils	0.67	own results
	1.63	own results
	5.16	own results
	9.57	own results

*in preparation

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